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LANL Material Control Indicator Analysis Program

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Abstract

The possibility of SNM diversion/theft is a major concern to organizations charged with control of Special Nuclear Material (SNM). Several methods have been put in place to deter and or detect losses of SNM. These include inventory, material control physical barriers and the use of material control indicators (MCI).

This paper will discuss the multi-tier LANL review mechanism for detecting and isolating missing SNM by the use of Material Control Indicators. Los Alamos' MCI include daily analysis and review of item adjustments, weekly review of item adjustments, monthly analysis and review of inventory differences by Process Status and by Material Balance Areas, and quarterly analysis and review of Propagation of Variance.

This paper, by providing an introduction to a site-specific application of MCI's, assists safeguards professionals in understanding the importance of an MCI Program in detecting accumulation for subsequent diversion/theft of special nuclear material.

Introduction

The Material Control Indicators Program is required by DOE Order 474.1 and outlined in DOE Manual 474.1-1 Chapter II Section 6. The manual lists requirements for evaluating Shipper Receiver Differences and Inventory Differences by Trending Analysis and Propagation of Variance for each Material Balance Area (MBA).

The MCI program assists LANL in assessing key indicators to provide assurance that losses and unauthorized removals of special nuclear material are detected in a timely fashion. Each indicator has an associated action limit(s). The key indicators and their evaluation frequency include:

1. Annual Trending of Shipper/Receiver Differences (S/RD)
2. Evaluation of Inventory Differences
 - a. Daily Item Adjustment (IA) review by Nuclear Materials Technology, Accountability Group (NMT-4)
 - b. Weekly Item Adjustment review by Safeguards and Security, Material Control and Accountability Group (S-4)
 - c. Monthly Inventory Difference (ID) Trending Analysis by S-4
 - d. Monthly Non Physical Parent Lot (NPPL) review by S-4
 - e. Quarterly Normal Operating Losses (NOL) review by S-4
 - f. Quarterly Propagation of Variance (POV) analysis by S-4, NMT-4 and Statistical Sciences Group (D-1).

The Graded Safeguards concept is applied to the MCI program, as allowed by DOE O 474.1. Hence, the program is based on SNM throughput, attractiveness level, and the number of inventory differences performed in a given month. This program monitors ID's at the Process Status (P/S) and MBA level. ID trending by MBA is reported to NNSA/AL on a monthly basis. S-4 trends ID's by P/S since several MBA's contain P/S which may not correlate to each other, and may have processes which cross MBA boundaries. This method also allows locating gains and losses much more readily.

1. Shipper/Receiver Difference Evaluation

Due to the low number of Shipper/Receiver Difference data points, trend analysis is only performed on an annual basis. S-4 uses a trending chart (i.e. charts with no control limits) as a visual tool to detect trends, cycles, and systematic biases. The following conditions indicate abnormal situations:

- ◆ Six consecutive points either above or below the average,
- ◆ Six consecutive points either increasing or decreasing,
- ◆ Eleven consecutive points alternating above and below the average.

If one of the above conditions exist, S-4 notifies the Nuclear Material Custodians (NMC) of the shipping and receiving facilities, who investigate the reason for the change in the shipper/receiver differences.

2. Inventory Difference Evaluation

Item adjustments are entries into the accounting records that reflect a justified, approved, and documented value change to an item. Approved item adjustments made at LANL include accidental losses, approved write-offs, decay, routine tests, NOLs, and NPPLs.

a. Daily Item Adjustment review by NMT-4

Performing item adjustments is an ongoing and dynamic process. NMT-4 is responsible for approving and updating the MASS system on a daily basis. NMT-4 investigates any adjustments which do not seem reasonable based on years of experience and knowledge of the process. The MASS system is updated daily to reflect all the changes on a real time accountability system.

b. Weekly Item Adjustment review by S-4

The item adjustments are reported daily and printed on a report called the N-14. S-4 reviews the N-14 report on a weekly basis and questions all adjustments which exceed 100 grams to assure SNM is not being accumulated for future diversion or held up in glove boxes or process lines which could lead to a criticality concern.

c. Monthly Inventory Difference Trending Analysis by S-4

All the item adjustments are summed for each process and an inventory difference is determined and reported on a monthly basis on a report called the Inventory Difference Throughput (IDTP) report. S-4 reviews the data and plots the ID's for highly active processes on a monthly basis. Processes which have a high activity (i.e. many IA's or high mass throughput) are easier to monitor using plots whereas low activity processes are more easily monitored by looking at tabulated data.

d. Monthly Non-Physical Parent Lot review by S-4

NPPL's are not real items; instead, they are temporary inventory adjustments, pending adjustment resolution. S-4 reviews all NPPL's on a monthly basis. If established timeline or gram limits are exceeded inquiries are made to assure that this avenue is not being used as means of diverting SNM.

e. Quarterly Normal Operating Losses review by S-4

Normal operating losses are handled and reported according to NNSA/AL requirements. Before the removal of material, S-4 reviews every NOL for approval. This review ensures that the material does not exceed safeguards termination limits nor economic discard limits, and the values indicated on MASS are correct. SNM requested by the Nuclear Material Custodian to be written off as a normal operation loss (NOL) is trended by S-4. Trend charts have administrative limits based on the "Safeguards Termination" memo of November 1995 written by D.W. Crawford. All individual NOL requests are plotted on a trending chart for the respective MBA. Requests that exceed the established administrative limits are subjected to additional reviews. If the NOL is rejected by S-4, an investigation by the NMC is required.

f. Quarterly Propagation of Variance analysis by S-4, NMT-4, and D-1

A POV is a statistically valid approach performed on those processes that meet the criteria for both high frequency of inventory difference and high throughput. D-1 performs the POV analysis and limits are calculated at the 95% warning limit and 99% alarm limit per NNSA/AL requirements. It is understood that the POV model results are not stand-alone results and are to be used and evaluated in conjunction with process activity reviews by NMT-4 and S-4 personnel.

POV Model Assumptions:

1. All beginning inventory values are statistically independent,
2. All ending inventory values are dependent by instrument group,
3. Assays are correlated within instrument type and are independent between groups,
4. The measurement codes are meaningful, and
5. All relevant activity for a particular month is included.

The model is adjusted to fit the data both monthly and cumulatively over a twelve-month period. Time plots show the inventory differences and the limits of error on a month-to-month basis for each P/S and by summary material type combinations where sufficient data exists.

The POV model assumes all uncertainties are appropriate, and the process inventory differences are independent. These ideal assumptions yield a condition where 95% of the inventory differences would be covered. The POV data is reviewed on an annual basis by D-1, NMT-4 and S-4 and updated as necessary. Also, D-1 continues to refine the model by collecting and assessing additional data. NNSA/AL is provided with a quarterly POV report summarizing the results of the analysis.

If the inventory difference falls outside of a warning limit, S-4 notifies the NMC for investigation, and corrective actions are taken. Corrective actions could include a correction in data used in the propagation of variance, a change in the value of the limits, and/or an adjustment in the

process/procedures within the affected process or MBA. If there is a change in the frequency of inventory difference and/or the level of throughput, the statistical test for the process is changed.

If the data fall outside of an alarm limit, S-4 notifies the LANL responsible group managers and an investigation is performed. If the investigation results are inclusive, an occurrence report is filed as per DOE Order 232.1, Occurrence Reporting.

Conclusion

LANL has implemented a multi-tiered MCI program to assist in the timely detection of SNM accumulation for future diversion. This is achieved by trending IDs and performing POV analysis on a periodic basis. Further, the graded safeguards approach was integrated into the program to maximize the use of resources.